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SUPERFUND'S STANDARD DEFAULT EXPOSURE FACTORS FOR THE CENTRAL TENDENCY AND REASONABLE MAXIMUM EXPOSURE

PRELIMINARY REVIEW DRAFT (5/5/93)

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1.0 INTRODUCTION

Last spring, EPA's Risk Assessment Council released a memorandum entitled "Guidance on Risk Characterization for Risk Managers and Risk Assessors" (U.S. EPA 1992) in which the council advocated greater interface between risk assessment and risk management, greater discussion of confidence and uncertainty in the risk assessment, and presentation of the range of possible exposures including the use of multiple risk descriptors. Focusing specifically on this last point regarding the exposure assessment, the Risk Assessment Council (RAC) clearly indicated that it expects all risk assessments "to address or provide descriptions of (1) individual risk to include the central tendency and high end portions of the risk distribution, (2) important subgroups of the population such as highly exposed or highly susceptible groups or individuals, if known, and (3) population risk".

For several years now, the Superfund program has considered exposure to sensitive subgroups or populations as applicable and has been estimating individual risk corresponding to the reasonable maximum exposure (RME). The <u>Risk Assessment Guidance for Superfund: Human Health Evaluation Manual (Part A)</u> (U.S. EPA 1989) also known as RAGS, defines the RME as the highest exposure that is reasonably expected to occur at a site and in practice is estimated by combining 90 - 95th percentile values for some but not all exposure parameters. Shortly after RAGS was released, the Superfund Program developed the "Standard Default Exposure Factors" Supplemental Guidance (U.S. EPA 1991) to promote consistency in the evaluation of the RME exposure in baseline risk assessments when site-specific data was lacking. It is the position of the Superfund Program that RAGS and the standard default values for the RME are consistent with the Risk Assessment Council's expectation to provide a description of the high-end portion of the risk distribution.

Until the guidance contained herein was developed, existing Superfund guidance did not provide a framework in which to estimate risk corresponding to the central tendency portion of the risk distribution as called for by the Risk Assessment Council. Perceiving a need to fill this void, a workgroup was organized by the Superfund Program in October of 1992, comprised mainly of EPA Regional Superfund risk assessors, with the purpose of defining the central tendency for use in Superfund baseline risk assessments. Over the course of the following six months, the workgroup convened periodically to discuss an approach and identify standard default exposure factors for the central tendency. In doing so, the workgroup also felt it beneficial to review the current default exposure factors for the RME and identify whether any changes were warranted at this time. Consequently, this guidance builds on the concepts identified in RAGS Part A and the Risk Assessment Council's recommendations regarding risk descriptors for the central tendency. It supersedes the standard default exposure factors for the RME contained in the guidance of the same name (U.S. EPA 1991).

Reliance on the point estimate approach vs. the use of monte carlo techniques to characterize the range of possible exposure estimates was initially discussed by the workgroup as both approaches have merit in addressing the Risk Assessment Council's call to present the range of possible exposures and risk outcomes. In the end, the workgroup concluded that too many issues regarding the practical application of monte carlo techniques remained unresolved and would require a significant investment of time and resources to address such that the traditional point estimate approach to exposure assessments was favored at this time. Additionally, the point estimate approach to exposure was deemed fully consistent with the intent of the Risk Assessment Council in their memo.

As there presently is an agency-wide effort underway to address all of the Risk Assessment Council's recommendations (including the use of monte carlo techniques and revisions to EPA's Exposure Factors Handbook incorporating distributions for the various exposure parameters), the guidance contained herein for the Superfund Program is subject to change and consequently should be viewed as interim in status. When such agency-wide guidance is available, it is expected that it may supersede this guidance.

The guidance contained herein has been developed to encourage a consistent approach to assessing exposures when there is a lack of site-specific data or consensus on which parameter value to choose, given a range of possibilities. Accordingly, the exposure factors presented in this document are generally considered most appropriate and should be used in baseline risk assessments unless alternate or site-specific values can be clearly justified by supporting data.

Supporting data for many of the exposure factors presented in this guidance can be found in the Exposure Factors Handbook (EFH; U.S. EPA, 1990). Additionally, in some instances, peer reviewed studies were utilized to identify suitable default values as well as group consensus techniques when a faced with a great deal of uncertainty. In these instances, either the study or a clearly documented logical approach used to identify default factors is referenced.

The general exposure equation into which these standard factors are to be utilized is as follows:

$$\text{Intake} = \frac{C \times IR \times EF \times ED}{BW \times AT} \quad \text{where}$$

C = Concentration of the contaminant in a given medium
IR = Intake/Contact Rate; the amount of contaminated medium contacted per unit time or event
EF = Exposure Frequency

ED = Exposure Duration
BW = Body Weight
AT = Averaging Time (equal to exposure duration for non-carcinogens and 70 years for carcinogens)

1.1 Central Tendency (CT)

The Risk Assessment Council defined the central tendency risk descriptor as either the arithmetic mean risk or the median risk and continues to say that the arithmetic mean risk can be derived by using average values for all the exposure factors though cautions that when dealing with skewed data, the median or 50th percentile may better approximate the midpoint of a distribution (U.S. EPA 1992). As a result, any approach to the identification of default factors for the central tendency should seek to identify average or 50th percentile values whenever possible. In keeping with this approach, default exposure factors approximating the average or 50th percentile value have been identified whenever possible for use in central tendency exposure evaluations.

1.2 Reasonable Maximum Exposure (RME)

The Risk Assessment Council defined a high end risk descriptor as one which characterizes risk to an individual at the upper end of the risk distribution. Conceptually, it can be equated to about the 90th percentile of the population distribution (U.S. EPA 1992). As previously indicated, the reasonable maximum exposure (RME) terminology used by the Superfund Program is believed consistent with this description. The Risk Assessment Guidance for Superfund: Human Health Evaluation Manual (Part A) (RAGS) defines the RME as the highest exposure that is reasonably expected to occur at a site and in practice is estimated by combining upper bound (90 - 95th percentile) values for some but not all exposure parameters. Consequently, the Superfund Program will continue to use the current terminology of reasonable maximum exposure (RME) in fulfilling the Risk Assessment Council's mandate to evaluate a high end risk descriptor.

In keeping with the previous default factor guidance (U.S. EPA 1991), 90 to 95th percentile values were targeted in this guidance document when identifying default factors for intake/contact rate, exposure frequency, and exposure duration. An average value or conservative estimate of the media average contacted over the exposure period was targeted for identification of default values for body weight and exposure concentration respectively.

Within the context of this guidance, standard default exposure factors have been identified for various exposure pathways and receptor populations owing to the different nature and magnitude of the assumed exposure. Generally speaking, default values for residential and occupational receptors have been identified and serve as the general basis for organization of this guidance.

1.3 Residential Exposure

Residential default exposure factors are generally relevant whenever there are or reasonably may be expected to be residences on or adjacent to the site. The contamination may be on the site itself or may have migrated from it. With the exception of exposure to contaminated soils, distinctions are not usually made in the default parameters for exposures to different aged receptors. Because of the higher intake to body weight ratio presumed to occur during the early years (ages 1-6) for this exposure pathway, special attention should be given to evaluating exposure for this pathway and is discussed in sections 7.4. and 7.5.

1.4 Occupational Exposure

Occupational default exposure factors are generally relevant whenever the site serves or may reasonably be expected to serve as a place of temporary or permanent employment. Examples of employment in which one may be presumed to come in contact with contaminated media might include employment at the facility itself or nearby facilities (commercial/ industrial), servicing of the facility (grounds keeper/utility maintenance), or construction of new facilities or the demolition of old facilities on or adjacent to the site.

2.0 CONCENTRATION

Central Tendency and RME

The concentration term in the intake equation is the arithmetic average of the concentration that is contacted over the exposure period. Because of the uncertainty associated with any estimate of exposure concentration, the 95% percent upper confidence limit on the arithmetic average concentration will be used for this variable in both the central tendency and reasonable maximum exposure estimates. Consideration should be given to the data set upon which the 95% upper confidence limit of the mean value is generated so as to represent as closely as possible the nature (acute vs. chronic) of potential exposures.

In some instances, there may be great variability in measured or modeled concentration values such as when too few samples are taken or when model inputs are uncertain. In these cases, the upper confidence limit on the average concentration may even exceed the maximum value observed or predicted. Should this scenario arise, then the simple arithmetic mean and maximum concentrations should be used for the central tendency and reasonable maximum exposure concentrations respectively.

3.0 EXPOSURE FREQUENCY

The following default exposure frequencies may be utilized unless otherwise indicated or site-specific data is available.

3.1 Central Tendency

3.1.1 Residential

The central tendency residential default exposure frequency of 234 days/year corresponds to the fraction of time estimated that is actually spent at home (64 percent) for both men and women based on a study of time use patterns summarized in the EFH (U.S. EPA 1990). Because the study included both personal and work related travel, a 365 day year was used from which to compute the 64 percent.

3.1.2 Occupational ?

3.2 Reasonable Maximum Exposure

3.2.1 Residential

The RME residential default exposure frequency of 350 days/year is based on the previously identified default value which assumes a two week vacation each year. This is viewed as a reasonably conservative estimate of exposure frequency absent site-specific data.

3.2.2 Occupational

The RME occupational default exposure frequency of 250 days/year is consistent with the previously identified default value and is based on a 5 day work week with two weeks of vacation each year. This is viewed as a reasonably conservative estimate of exposure frequency absent site-specific data.

4.0 EXPOSURE DURATION

The following default exposure durations may be utilized unless otherwise indicated or site-specific data is available.

4.1 Central Tendency

4.1.1 Residential

The residential central tendency default exposure duration of 9 years is based on data summarized in the EFH (U.S. EPA 1990) in which the average length of residence in the same house of people who own their own home was estimated to be 9 years.

4.1.2 Occupational ?

4.2 Reasonable Maximum Exposure

4.2.1 Residential

The RME residential default exposure duration of 30 years is based on data summarized in the EFH (U.S. EPA 1990) in which the 90th percentile for the length of residence in the same house of people who own their own home was estimated to be 30 years.

4.2.2 Occupational

The RME occupational default exposure duration of 25 years is based upon the 95th percentile for the number of years worked at the same location as reported by the U.S. Bureau of Labor Statistics, 1990.

5.0 BODY WEIGHT

The average body weight is to be utilized for both the central tendency and RME exposure evaluations in keeping with the respective definitions.

5.1 Child

The approximate average body weight of young children (boys and girls combined) under the age of 6 years is approximately 15 kg (U.S. EPA 1990). Distributions of body weights and average body weights and for other age groups can be found in the EFH (U.S. EPA 1990).

5.2 Adult

The average body weight of 70 kg corresponds to the average weight of men and women age 18-75 as reported in EFH (U.S. EPA 1990). Distributions of body weights and average body weights for other age groups can be found in the EFH (U.S. EPA 1990).

6.0 INGESTION OF POTABLE WATER

6.1 Central Tendency

6.1.1. Residential Ingestion Rate

The central tendency potable water ingestion rate for an adult of 1.4 l/day is based on the average intake observed from five studies as summarized in the EFH (U.S. EPA 1990). The observed range reported across the five studies was from 0.26 - 2.8 l/day.

6.1.2 Occupational Ingestion Rate

No data upon which to base a default value.

6.2 Reasonable Maximum Exposure

6.2.1 Residential Ingestion Rate

The RME potable water ingestion rate of 2 l/day is close to the 90th percentile of values measured and estimated by researchers as summarized in EFH (U.S. EPA 1990). It is also the value currently used by EPA's Office of Water in establishing drinking water standards.

6.2.2. Occupational Ingestion Rate
No data upon which to base a default value.

7.0 INGESTION OF SOIL AND DUST

Due to the importance of the receptor's age and behavioral characteristics, default ingestion rates for this exposure pathway have been established based on the characteristics of the receptor rather than on the location of the exposure (residential vs. occupational). Default ingestion rates for this pathway are as described below in Sections 7.1 and 7.2.

7.1 Central Tendency

7.1.1. Child's Ingestion Rate
Numerous studies have documented that the propensity to ingest non-food items is greatest in the early years of development. As a result, children between the ages of 1 and 6 years are of greatest concern as they are expected to have the greatest exposure to contaminated soils and dusts via ingestion. Numerous studies (tracer studies and estimates of deposition/exposed surface area) have resulted in wide ranging estimates of the amount of soil and dusts ingested by young children making it difficult to identify a single value for use as the central tendency. Additionally, owing to the nature of the experimental studies, it is extremely difficult to separate the contribution to exposure resulting from exterior soils vs. interior dusts. As a result the ingestion rate is reported as the combined rate for soils and dusts.

It was believed by a consensus of workgroup members that the ingestion rate of 100 mg/day as a central tendency ingestion rate for a child between the ages of 1-6 years was within reason based on results using tracer elements (Davis et al. 1990 and Calabrese 1989). Furthermore, 100 mg/day is nearly identical to the ingestion rate for this age group based on age specific values utilized in support of the NAAQS for lead (U.S. EPA 1989b) and the lead biokinetic uptake model.

7.1.2 Adult's Ingestion Rate: Non-Contact Intensive
For the adult who does not engage in soil or dust contact intensive activities on a regular basis (apartment dweller, typical homeowner, office worker, teacher, professional, etc.) the soil and dust default ingestion rate for the central tendency of 50 mg/day based on a study of Calabrese 1990 (with supporting estimates from Hawley 1985).

7.1.3 Adult's Ingestion Rate: Contact Intensive
For adults who routinely engage in heavy contact with soils and dusts on a regular basis (including seasonal work), the workgroup was unable to identify a default

soil ingestion rate corresponding to the central tendency given the data available. It is suggested that an evaluation of the RME scenario for this receptor be conducted.

7.1.4. Residential: Child + Adult Combined
In evaluating a residential exposure scenario for this pathway, a weighted average of the child's and adult's exposure is to be utilized. The duration of exposure for the central tendency has been defined as consisting of nine years (average number for years at the same dwelling). It is the default position to assume that for 2 of the nine years, intake will be at the child's rate and for the remaining 7 years, intake will be at the adult rate. This is consistent with the proportion of time one is assumed to be a young child that is utilized for RME residential calculations. Thus residential exposure for the central tendency should generally be evaluated as follows:

$$\frac{2\text{ years} \times 100\text{ mg/day}}{15\text{ kg}} + \frac{7\text{ years} \times 50\text{ mg/day}}{70\text{ kg}}$$

7.1.5 Exposure Frequency and Duration: Central Tendency
The default value for the duration of exposure for the central tendency scenario is 9 years for a residential exposure based on the average length of stay in a home as reported in the EFH (U.S.EPA 1990). It should be noted that generally the intake over the 9 year exposure period is to be computed as described in section 7.1.4. The default exposure frequency for the central tendency is 350 days/year due to the nature in which the soil ingestion rates have been computed (average daily exposure).

A default exposure frequency and duration has not been specified for the central tendency occupational scenario at this time as it has not been discussed by the workgroup.

7.2 Reasonable Maximum Exposure

7.2.1 Child's Ingestion Rate
The default RME ingestion rate for a young child age 1-6 years of age of 200 mg/day represents the consensus opinion of the workgroup based on review of available data and is believed to correspond to a conservative estimate of an average ingestion rate for this age group over a chronic period of exposure.
Unfortunately, the available data did not support identification of the 90 or 95 percentile value. It was the consensus among workgroup participants that over the 6 year period of concern for this receptor category, the value of 200 mg/day was reasonable to

assume. It should be noted that this value was not necessarily deemed relevant for acute exposures when a child may engage in intensive contact with soils and dusts for a brief period of time. In these situations, ingestion rates greater than this value may be warranted.

7.2.2 Adult's Ingestion Rate: Non-Contact Intensive
The RME default soil and dust ingestion rate of 100 mg/day is based a study of Sedman (1989). This value is presumed suitable for non-contact intensive scenarios (apartment dweller, typical homeowner, office worker, teacher, professional, etc.).

7.2.3 Adult's Ingestion Rate: Contact Intensive
The RME default soil and dust ingestion rate of 480 mg/day is deemed appropriate for acute exposures (those less than a year in duration). This value is based on estimates made by Hawley (1985) in which he estimated deposition rates, exposed surface areas of the hands, and the fraction inadvertently consumed.

7.2.4 Residential: Child + Adult
In evaluating a residential RME exposure scenario, the exposure duration for the RME has been defined as consisting of 30 years (90 percentile for years at the same dwelling U.S. EPA 1990). It shall generally assumed when evaluating the RME residential exposure for the ingestion of soil and dusts that for 6 of the 30 years, intake will be at the child's rate and for the remaining 24 years, intake will be at the adult rate. Thus residential RME exposure for this pathway should generally be evaluated as follows:

$$\frac{6 \text{ years} \times 200 \text{ mg/day}}{15 \text{ kg}} + \frac{24 \text{ years} \times 100 \text{ mg/day}}{70 \text{ kg}}$$

7.2.5 Exposure Frequency and Duration: RME
The default value for the duration of exposure for the RME scenario is 30 years for a residential exposure based on the 90th percentile for the length of stay in a home as reported in the EFH (U.S.EPA 1990). It should be noted that generally the intake over the 30 year exposure period is to be computed as described in section 7.2.4. The default exposure frequency for the RME is 350 days/year due to the nature in which the soil ingestion rates have been computed (average daily exposure) and assuming a two week period away from home each year.

The default value for the duration of exposure for the RME occupational scenario is 25 years based on the 95th percentile for the number of years worked at the same location (Bureau of Labor Statistics 1990). The exposure frequency of 250 days/year corresponds to a five day work week.

7.3 General Exposure Frequency and Duration Considerations
Owing to the strong age and behavioral dependent nature of this exposure, exposure durations and frequencies other than the default values may be warranted for this exposure pathway. For example, a situation may arise in which a child-care facility is of concern and the residential default values for exposure frequency and duration may not be appropriate. Similarly, certain occupations may lead to intensive exposure but for brief periods of time (i.e. construction workers, field laborers, seasonal workers, etc.) rendering use of the occupational default values for exposure frequency and duration inappropriate.

Additionally, there may be situations in which a Region believes it necessary to adjust the exposure frequency to account for meteorological conditions which may be presumed to drastically reduce or eliminate exposure to potential contaminants via soil ingestion. In these situations, any adjustments to the exposure frequency to reflect local weather patterns should first be approved by the Regional Office.

For these reasons, the default exposure durations and exposure frequencies may not always be relevant for the exposure at hand. Extra care should be taken when identifying suitable exposure frequencies and durations for this exposure pathway.

7.4 Fraction Ingested From the Contaminated Source
The fraction ingested from the contaminated source is an important variable that often gets overlooked when evaluating scenarios that are largely dependent on the receptor coming to the source of contamination rather than the contamination migrating to the receptor. Due to variations in the proximity of the receptor to the contaminated source, size of the contaminated source, receptors of concern, mobility of receptors, and the nature of exposure, default values for the fraction ingested from the contaminated source are not possible. However, it is advocated that this factor be given extra careful consideration when evaluating this exposure pathway.

7.5 Matrix Effect
A parameter unique to all combinations of compounds and soil types- the matrix effect - accounts for the tendency of a compound to bind to soils. The more "soil loving" a compound is, the less likely it is to

desorb and become bioavailable in the gastrointestinal tract once ingested. Chemical and physical properties of contaminants and the soil can thus have a profound effect on the bioavailability of a compound. Unfortunately the data do not exist to support default desorption values for all compounds at this time though work is currently underway to develop some guidance in this area. At present, any adjustments for this phenomenon are left open to the discretion of the Regional Office.

8.0 INHALATION OF CONTAMINANTS

It is anticipated that at some time in the future, inhalation exposures will be evaluated using inhalation reference concentrations. However, at this time, the methodology is not yet available and consequently, inhalation rates and resulting dose (mg/kg/day) are the approach that is advocated for this exposure pathway. Inhalation rates are dependent on age, sex, and activity level to name just a few factors and can be found in the Exposure Factors Handbook (U.S. EPA 1990).

The same default inhalation rate has been identified for both the central tendency and the RME exposure scenarios. This is in keeping with the assumption regarding inhalation rate used in the derivation of cancer potency estimates and inhalation reference concentrations. The default value of 20 m^3/day corresponds to a reference man's inhalation rate who is at rest 8 hours/day and at a light activity level (i.e. domestic work, personal care, hobbies, minor indoor home improvements) for the remaining 16 hours/day.

9.0 INGESTION OF LOCALLY CAUGHT FISH

The evaluation of this exposure pathway will not always be relevant to every site. The receptor of concern for this pathway is apt to include both the recreational fisherman and a subsistence fisherman and their family. The preferred approach to the evaluation of this exposure pathway is to obtain site-specific data regarding consumption rates and fishing habits. This is due to the strong influence of local habits, populations, and conditions on the resulting exposure.

When site-specific data are not feasible to obtain, the default approach suggested for this exposure pathway is based on an estimate of the average size of a fish meal and merely varies the exposure frequency, duration, and fraction ingested from the contaminated source between the central tendency and the RME estimates. With this approach, recreational and subsistence fishermen can be assumed to consume the same amount of fish per eating occasion yet differ in the frequency or number of fish meals actually consumed and the fraction of fish meals consumed that originated from the contaminated source. This change in approach was adopted because it was believed to better characterize exposure resulting from an intermittent and often infrequent exposure pathway than the default approach previously advocated which relied on an intake rate averaged over a year of exposure.

The average amount of fish consumed per eating occasion was observed to be 145 g/meal or about 5 ounces as reported in the study of Pao et al. (1982). The range reported for the size of the fish meal was from 43 g/meal (5th percentile) to 565 g/meal (99th percentile). The study was based on the results of a self-administered USDA nationwide consumption survey from 1977-78 of individuals in 48 states. The amount of fish corresponds to consumption habits for fin-fish as reported on a wet weight basis. It does not include shellfish. Although fish consumption habits have likely increased over the past 15 years, the Pao study was believed to be the best study available upon which to base a default value.

Owing to the very site-specific nature of the frequency of this exposure, no defaults are given at this time for exposure frequency (fish meals/year). However, estimates of the average and 90th - 95th percentile for the frequency of exposure should be used for the central tendency and RME respectively. Default values for exposure duration are those which are consistent with residential default values previously identified of 9 years for the central tendency and 30 years for the RME. Additionally, it was believed that a site-specific value for the fraction of fish consumed from the contaminated source was appropriate rather than establishing a default value for this factor. The average and the 90th - 95th percentile values are suggested for the central tendency and RME for this parameter respectively.

10.0 INGESTION OF PRODUCE

The following approach has been suggested for this exposure pathway provided it is relevant to the risk evaluation:

a. Strongly consider evaluating consumption of homegrown produce if it constitutes a current exposure pathway and if produce is available for analysis. If produce is not available for analysis, evaluation of this exposure pathway is open to the discretion of the Regional Office (recognizing that this decision is apt to depend on the level of confidence in available plant uptake models).

b. If the decision is made to employ an uptake model, the Region is strongly encouraged to seek the assistance and/or review of the proposed approach by ECAO-Cincinnati.

c. When evaluating this exposure pathway, preference should be given for site specific consumption rates (obtainable via door to door surveys) if feasible. When site specific consumption rates are not feasible, either generic defaults regarding total consumption rates for all fruits combined or all vegetables combined (USDA 1980) or defaults based on the average amount of a fruit or vegetable consumed on a given eating occasion (Pao et al. 1982) together with site specific exposure frequencies is suggested.

d. The fraction ingested assumed to originate from a contaminated source will always be a site specific determination.

The choice of which of the approaches described below should be utilized for the identification of default ingestion rate values is left up to the risk assessor based on their understanding of the site. The USDA (1980) results are based on the average consumption rate as self-reported over a three day period and included non-consumers as well as consumers in the calculation. In contrast, the data of interest from Pao et al.(1982) focused on the amount consumed of various food crops for a given eating occasion. If and when default values are used, the same ingestion rate utilized for the central tendency is advocated for use in evaluating the RME scenario. It is suggested that in these instances, merely the exposure frequency, duration, and the fraction ingested from the contaminated source vary between the central tendency and the RME evaluations.

10.1 Total Produce Consumption Rates (USDA 1980, U.S. EPA 1990)

As summarized in the EFH (U.S. EPA 1990), the USDA estimated the average intake on any one day of all fruits combined as 142 g/day per person and approximately 1/5 of this (28 g/day) could be assumed to be homegrown on average or as much as 3/10 of this (42 g/day) could be assumed tc be homegrown as a reasonable maximum exposure case.

The average intake on any one day for all vegetables combined was estimated as 201 g/day. Furthermore, approximately 1/4 (50 g/day) of this amount could be assumed to be homegrown on average and as much as 2/5 (80 g/day) could be assumed to be homegrown as a reasonable maximum exposure case.

Due to the nature of the study, (a daily average intake over a three day exposure period), it can be assumed that the contact rates represent a chronic value. If this approach is selected, then the exposure frequency for the central tendency and RME should be 350 days/year. The default exposure duration reflects the residential central tendency value of 9 years or 30 years for the RME scenario. Assumptions regarding the fraction ingested from the contaminated source are not specified though national averages for the fraction that can be assumed to be homegrown have been suggested as a described above.

10.2 Crop Specific Consumption Habits (Pao et al. 1982)

As summarized in the attached table, average values for the amount of a particular fruit or vegetable consumed on a given eating occasion can be identified based on the results of a nationwide survey conducted by the USDA as summarized in Pao et al. (1982). Additionally, the authors' reported the distribution of consumption values observed for each fruit or vegetable included in the survey. The Pao et al. data was based on the USDA nationwide food consumption survey conducted in 1977-78.

Default values for the frequency of exposure have not been identified and are subject to site-specific determinations reflecting local consumption habits. The default exposure duration reflects the residential central tendency value of 9 years or 30 years for the RME scenario. The fraction ingested originating from the contaminated source has not been specified but is open to consideration of site-specific factors.

SUMMARY OF STANDARD DEFAULT EXPOSURE FACTORS
PRELIMINARY REVIEW DRAFT (5/5/93)

CENTRAL TENDENCY

Exposure Pathway	Contact Rate	Frequency	Duration	Body Weight
1. Ingestion of Drinking Water				
1a. Residential	1.4 l/day	350(a)	9 years	70 kg
1b. Occupational ?	1 l ?	250 ?	? 5(b)	70 kg
2. Ingestion of Soil and Dusts[2]				
2a. Child - residential	100 mg/day	350 days/yr[1]	2 years	15 kg
2b. Adult - Non-contact residential	50 mg/day	350 days/yr[1]	7 years	70 kg
2c. Adult - Non-contact occupational	50 mg/day	?	?	70 kg
2d. Adult - Contact Intensive	data insufficient (100)			
3. Inhalation				
3a. Residential	20 m^3/day	234 days/yr	9 years	70 kg
3b. Occupational ?	?	?	?	70 kg
4. Fish Ingestion[2]	145 g/meal	site specific average	9 years	70 kg
5. Ingestion of Produce[2]	142 g/day (fruits) 201 g/day (veg.) or produce specific value for amount per meal (see attachment)	350 days/yr for values indicated or site-specific average if use amt./meal	9 years	70 kg

REASONABLE MAXIMUM EXPOSURE

Exposure Pathway	Contact Rate	Frequency	Duration	Body Weight
1. Ingestion of Drinking Water				
1a. Residential	2 l/day	350 days/yr	30 years	70 kg
1b. Occupational ?	1 l(a) ?	250 ?(a)	? 25(a)	? 70 kg
2. Ingestion of Soil and Dusts[2]				
2a. Child - residential	200 mg/day	350 days/yr[1]	6 years	15 kg
2b. Adult - Non-contact residential	100 mg/day	350 days/yr[1]	24 years	70 kg
2c. Adult - Non-contact occupational	100 mg/day	250 days/yr[1]	25 years	70 kg
2d. Adult - Contact Intensive	480 mg/day	site-specific	site-specific	70 kg
3. Inhalation				
3a. Residential	20 m^3/day	350 days/yr	30 years	70 kg
3b. Occupational ?	?	250 days/yr	25 years	70 kg
4. Fish Ingestion[2]	145 g/meal	site-specific 90-95th %	30 years	70 kg
5. Ingestion of Produce[2]	142 g/day (fruits) 201 g/day (veg.) or produce specific value for amount per meal (see attachment)	350 days/yr for values indicated or site-specific 90-95th % if use amt./meal	30 years	70 kg

(a)

[1]Adjustments based on behavioral or meterological conditions may be warranted based on site-specific conditions and Regional policies.

[2] Though not specified, exposure pathway should include a site-specific value for the fraction ingested originating from the contmainated source.

(a) OSWER Directive 9285.6-03

(b)

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Attachment 2

Quantity Consumed Per Eating Occasion of Various Fruits and Vegetables (grams)

Pao et. al. 1982

				Percentile							
	food category	avg.	std. dev.	5th	25th	50th	75th	90th	95th	99th	Max.
Fruit	fresh grapefruit	159	58	106	134	134	165	268	268	330	660
	fresh oranges	146	57	73	145	145	145	180	228	360	1160
	raw apples	141	49	69	138	138	138	212	212	276	636
	bananas	106	37	50	95	119	119	136	136	238	476
	cantaloup	171	91	61	136	136	272	272	272	529	896
	raw pears	163	69	82	164	164	164	164	328	328	2132
	raw peaches	160	75	76	152	152	152	304	304	456	760
	raisins	33	28	3	14	28	43	73	73	145	290
	raw strawberries	100	58	37	75	75	149	149	180	298	447
Raw Vegetables	white potatoes	125	90	29	63	105	170	235	280	426	1260
	cabbage /cole slaw	68	45	15	40	60	90	120	120	240	1020
	raw carrots	43	40	4	13	31	55	100	122	183	500
	raw celery	33	24	8	17	28	40	60	80	120	204
	raw cucumbers	80	76	8	24	70	110	158	220	316	840
	lettuce/tossed salads	65	59	10	20	55	93	140	186	270	1080
	raw onions	31	33	3	17	18	36	57	72	180	350
	raw tomoatoes	81	55	30	45	62	113	123	182	246	728
Cooked Vegetables[1]	cooked broccoli	112	68	30	78	90	155	185	190	350	680
	cooked cabbage	128	83	28	75	145	150	225	300	450	610
	cooked carrots	79	50	19	46	75	92	150	155	276	736
	corn on/off cob	95	56	21	65	83	123	170	170	330	850
	lima beans	110	75	21	67	88	170	175	219	350	875
	cow peas, field peas and blackeye peas	131	88	22	88	88	175	196	350	350	700
	cooked green peas	90	57	20	43	85	85	170	170	330	680
	cooked spinach	121	70	24	78	103	185	205	205	380	454
	string beans	86	54	18	67	70	135	140	140	280	840
	cooked summer squash	145	98	27	105	108	215	215	352	430	860
	cooked sweet potatoes	136	87	38	86	114	185	225	238	450	1020
	cucumber pickles	45	45	7	16	30	65	90	130	222	455

[1] Cooked vegetables includes canned.